

Work Plan: UMass Testing for Reservoir Monitoring

(Task 3.3.4.a.3)



This task originally called for sampling the 6 reservoirs¹ in the Cat/Del system as well as the 2 storage/balancing reservoirs² for a mid-level NOM characterization to be conducted at UMass. Subsequent discussions with the City and the JV led to the decision to sample five separate locations among the balancing reservoirs³. All reservoirs will be sampled a total of 20 times (monthly for 1 year, followed by quarterly for 2 years). The NOM analysis will include DOC, dissolved organic nitrogen, UV absorbance (200-600 nm), THMFP and HAAFP analysis.

Year 1 Sampling Load for Task 3.3.4.a.3

Number of Reservoirs	# of Samples/res/ yr	Total # of samples	Analyses
8	12	96	DOC, DON UV abs scan THM & HAA precursors

Year 2 and 3 Sampling Load for Task 3.3.4.a.3

Number of Reservoirs	# of Samples/res/ yr	Total # of samples	Analyses
8	4	64	DOC, DON UV abs scan THM & HAA precursors

UMass will provide annual summaries of the data collected. UMass will also present some interpretations of the data based on know climatic conditions and land use within the Cat/Del watershed.

¹ Cannonsville, Pepacton, Ashokan, Neversink, Rondout, and Schoharie Reservoirs

² Kensico and Hillview Reservoirs

³ Phone call between Bill Becker, Salome Freud and Dave Reckhow on 17 Oct 06. Decision was made to begin work by sampling two exit locations from Kensico and entry locations to the three City Tunnels just downstream of Hillview

Raw water from the 8 is transported to UMass:

- UMass Prepares coolers and sends them to DEP reservoir contacts
 - Locations and individuals are below
- Samples are collected by DEP personnel and shipped back to UMass via overnight courier
- DEP reservoir contacts are responsible for transferring DI water to travel blank bottle

Cooler Contents (total of 4 coolers needed)

1. Instructions on sampling and shipping
2. six 1-liter bottles (2 for each sampling location), plus two for the travel blank (one of these two will be filled with Elab II DI water)
 - a. Cooler to Flushing will require 8 1-liter bottles
 - b. Need to send 10 1-liter bottles to Delaware
3. Blue Ice packs ??

Shipping Location	Grahamsville (Delaware)	Kingston ⁴ (Catskill)	Valhalla (Kensico)	Flushing (Hillview)
# sampling locations	4	2	2	3
Name of sampling locations	Cannonsville, Pepacton, Neversink, Rondout	Ashokan, Schoharie	Kensico: Delaware effluent & Catskill effluent	Entry to tunnels #1, #2 and #3 downstream of chlorination
# of 1-liter bottles	10	6	6	8
Contact:	Kirsten Lewis	Sheila Brady	David Robinson	Virginia Murray
Telephone	(845) 985-7531		(914) 287 -7156	(718) 595 -6315
Email	klewis@dep.nyc.gov		DRobinson@dep.nyc.gov	vmurray@dep.nyc.gov
Address:	NYC DEP Grahamsville Laboratory 7870 Route 42 Grahamsville NY 12740	NYC-DEP Kingston Laboratory 71 Smith Avenue Kingston, NY 12401	NYC DEP Kensico Laboratory 19 West Lake Drive Valhalla NY 10595	59-17 Junction Blvd. 6 th floor Low Rise NYC DEP Distribution Lab Flushing, NY 11373
Alt contacts		Karen Hacker (845) 657 -7617	Stephanie Pratt	Devaraj Vijayakumar Steve Odomirok Makram Yacoub
Alt Phone		(845) 657 -2306	(914) 287-7142	(718) 595-6360
Alt email		khacker@dep.nyc.gov	Spratt@dep.nyc.gov	dvijayakumar@dep.nyc.gov sodomirok@dep.nyc.gov myacoub@dep.nyc.gov

⁴ Formerly Catskill samples were shipped to the Ben Nesin lab in Shokan; the was closed in February 2008 and replaced by the Kingston lab.

The overall NYC contact for this sampling is Kirsten Lewis of the Grahamsville Laboratory.

Initial Treatment/Preservation upon arrival at UMass

1. Ammonia:
 - a. freeze at -20C if samples cannot be run the day they arrive
2. Nitrate:
 - a. refrigerate at 4C, if samples can be run within 24 hours of receipt
 - b. otherwise acidify to pH 2 with H₂SO₄
3. DOC and DON
 - a. filter immediately upon receipt
 - b. acidify to pH 2 with H₂SO₄, and refrigerate if samples can't be run immediately
4. DBP precursor tests
 - a. refrigerate at 4C, begin chlorination test ASAP, but no later than 24 hours after receipt
5. UV absorbance scans
 - a. run immediately on filtered sample

Summary of UMass chlorination treatment protocol

1. Raw water (Cat/Del & Kensico)
 - Add buffer
 - pH 7.0
 - Add sodium hypochlorite
 - Standard dose
 - Hold for 7 days
 - Measure residual and Quench
 - Analyze DBPs
2. Treated water (Hillview or City Tunnels)
 - Hold for 48 hrs
 - Remove subsample
 - Measure residual & quench
 - Analyze DBPs
 - Add buffer
 - pH 7.0
 - Add sodium hypochlorite
 - Standard dose
 - Hold for 5 more days (total of 7 days Cl₂ contact)
 - Measure residual and Quench
 - Analyze DBPs

Preferred DBP Precursor Test Conditions

There is considerable variability in conditions used for DBP precursor tests. The table below lists some of the more common tests. Prior testing of the Cat/Del reservoirs by Stepczuk and colleagues (1998) and by Effler et al. (2003) involved a method similar to that published in Standard Methods. However, their chlorine residual criteria were vague and not exactly in accordance with the cited protocol.

Conditions	UFC Test	Effler et al., 2003	THMFP Std. Mth.	UMass method
Chlorine Residual ⁵ (mg/L)	1.0 ±0.4	>1.0	4.0 ±1.0	>2.0
Incubation Time (hr)	24 ±1	168	168	72 ±1
Temperature (°C)	20.0 ±1.0	25	25.0 ±2.0	20.0 ±1.0
pH	8.0 ±0.2	7.0	7.0 ±0.2	7.0 ±0.2
Bromide (mg/L)	ambient	ambient	ambient	ambient

For this task we will use a method that is in accord with the methods used previously (by Stepczuk & Effler), but we will try to keep residuals a bit higher in accordance with recommendation of Standard Methods.

Sequence

1. **Set** one controlled **temperature** chamber to 25 C, and the other to the NYC “ambient” water temperature
2. **Open** all **coolers** immediately upon receipt and note sample integrity (air spaces, broken bottles, etc.), note temperature of each cooler.
3. Place the three sets of replicate samples collected from the city tunnels (downstream of Hillview) directly into the “ambient” temperature chamber. Note the time of collection, as 48 hours after collection will be the processing time for this sample.
4. Pour a small **sample for TOC/TN** from each of the remaining 16 samples (RW samples)
 - 2 replicate bottles from each of the 6 Cat/Del reservoirs, and
 - 2 replicate bottles from each of 2 effluents from Kensico
5. **Filter** about 100 mL of each sample through a GF/F glass fiber filter and save for DOC/DN analysis and UV-Vis scans

⁵ At the end of the incubation time

6. Measure **UV-Vis** absorbance (collecting and saving full scan data from 200-500 nm) on all 16 samples that have not been chlorinated
7. Start Precursor test on all 16 **RW samples** plus each of the 4 field blanks
 - a. Determine chlorine doses for all 8 samples (6 Cat/Del samples & two samples from Kensico) that will give a 7-day residual near 4 mg/L.
 - i. from UV absorbance and prior experience with Kensico water and the 6 Cat/Del reservoirs
 - ii. use the average dose for the field blanks
 - b. Prepare a volume of all 8 samples (16 bottles total) for testing by first adjusting pH of about 1 liter volume of each to 7.0 by addition of a phosphate buffer. Do the same for each individual travel blank.
 - c. From each buffered sample, prepare 2 BOD bottles (one from each original sample bottle, totaling 16 BOD bottles) for chlorine treatment. Do the same for each individual travel blank (singlet).
 - d. Add the requisite chlorine dose to each, cap and place in the 25 C chamber
8. Begin processing **City Tunnel samples** at 48 hours from the time of collection
 - a. At 48 hrs, remove them from the “ambient” temperature chamber; inspect for headspace, and quickly process them as follows
 - b. for each of the 6 samples, pour off the requisite amount for THM and HAA analysis into vials with sulfite quench.
 - c. Place the remaining volume in the 25°C temperature chamber, allow them to reach the desired temperature (25°C).
 - d. prepare one BOD bottle from each sample bottle, buffer as with the Kensico samples, and dose with the requisite amount of chlorine for the precursor test. Return these samples into the 25°C temperature chamber to complete their 7 day contact (120 more hours)
 - e. Pour a sample from the remaining volume for THM analysis (accounting for loss of THMs due to volatilization)
 - f. use the remaining sample volume to analyze for chlorine residual
9. **Measure** TOC, DOC, TN, DN, ammonia, nitrate, and nitrite on all 16 RW samples and 4 field blanks; and DBP analysis on the 48-hour samples from the City Tunnels
10. After 7 days (168 hours) of chlorine contact time, remove samples, and begin processing
 - a. pour necessary volumes into vials for THM and HAA analysis with quench
 - b. measure chlorine residual
 - c. measure pH
11. Conduct DBP analyses on all 7-day chlorinated samples

Schedule (tentative):

1 st Run	23 Oct 06
2 nd Run	20 Nov 06
3 rd Run	11 Dec 06
4 th Run	16 Jan 07

5 th Run	20 Feb 07
6 th Run	19 Mar 07
7 th Run	16 Apr 07
8 th Run	21 May 07
9 th Run	18 Jun 07
10 th Run	16 July 07
11 th Run	20 Aug 07
12 th Run	17 Sept 07
13 th Run	10 Dec 07
14 th Run	17 Mar 08
15 th Run	16 Jun 08
16 th Run	15 Sept 08
17 th Run	8 Dec 08
18 th Run	16 Mar 09
19 th Run	15 Jun 09
20 th Run	21 Sept 09

This precursor assessment task is to be done once every month for the first year and every quarter for a 2 year period. Mondays were selected whenever possible as these are the dates that elevation tap samples are collected for reservoirs not in service. In most cases we have tried to pick the 3rd Monday of the month. These dates are subject to change in accordance with the ability of DEP personnel to collect and ship samples to UMass.

Between the first and second run, one of the PIs (Reckhow) will make a site visit to all 8 reservoirs.